Machine Learning for Transport Modelling

the Next Generation of Transport Models

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We offer solutions for communal companies: from the automotive sector to waste management

Industries & customers

- Rail
- Public Transport
- Mobility
- Supply
- Waste Management

Logos of various companies associated with these industries:

- DSB
- ÖBB
- SNCF
- SBB CFF FFS
- DB
- HOCHBahn
- movia
- ZVV
- Flughafen München
- VOLKSWAGEN GROUP
- MOIA
- bdew
- Berliner Wasserbetriebe
- AWM
- BERLIN RECYCLING
- RheinEnergie
- GETT
- WIENER LINIEN
- DAIMLER
- cIVITY Management Consultants
The strength of civity lies in the interaction of technical expertise and methodological competence.

"We understand tasks and issues of communal companies."

"We understand data analytics and its use."

"We moderate creativity-enhancing and sensitive."

Interaction of technical expertise and methodological competence
Our R&D projects depict an interesting contrast between new mobility providers and classic PT operators

### R&D projects for mobility demand forecasting

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>European Car-Manufacturer</strong></td>
<td>Identification and evaluation of the market potential for tier-2 cities in Europe based on mobile phone cell data. Derivation of a market entry strategy including a scalable value proposition for individual markets.</td>
</tr>
<tr>
<td><strong>civity matters No. 1</strong></td>
<td>Study on free-floating car sharing in European cities. The focus is on the evaluation of the traffic and economic relevance of the new system in comparison to public transport.</td>
</tr>
<tr>
<td><strong>LogFile Analysis</strong></td>
<td>Study for the evaluation of LogFiles generated via a PT information app. Correlation analyses with data from automated passenger counts. Conclusions on extrapolation of results.</td>
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</tbody>
</table>
Transport modelling is strongly influenced by innovations in methodology, computing capacity and data availability.

Relevant methods for transport modelling:

- **Classic Four-step Model**
  - Generation: (inbound-/outbound-) traffic volumes in spatial subsets (traffic cells) with trip generation
  - Distribution: Origin-destination-relations/trips between traffic cells through destination choice models
  - Mode choice
  - Route choice

- **Activity-based Model**
  - Additional formation of relevant groups of people and activity chains, e.g. home – working – shopping – home

- **Multi Agent Model**
  - Formation of a synthetic population with daily plans formed from alternating activities and routes; creation of a utility model; iterative optimisation of the resulting individual utility in order to maintain a system equilibrium.

- **xMND Project: Data Analytics / Business Analytics**
For the xMND-approach we use an machine learning approach to estimate mobility demand

Idea and first approach

- Floating Phone Data (FDP) $\rightarrow$ Origin-Destination-Matrix on postal code level
- Fine-grained data (~10m with 26 categories)
- Europe-wide dataset (cities and functional urban city areas)
- Many other fine-grained spatial data available
For the xMND-approach we use an machine learning approach to estimate mobility demand

Machine learning with floating phone data (ML FPD)

FPD (Postal zones / cells)

Other data sources

Urban Atlas Data

Regression models

Travel demand model

Aggregation

Merging
The first approach already shows mixed results

Initial results for German postal areas

**Mean absolute errors for estimations of incoming movements, workdays 4PM**

- Measured and modelled daily demand curves
- Mean Absolute Percentage Error: 57%
Additional spatial data and different approaches can lead to further improvements

**Main challenges**

**Data**
- Population data (Zensus)
- Area data (e.g. size)
- Bigger training set with more cities

**Models**
- OD-relations
- Adjusting layers
- Hyperparameter optimisation

**Projection**
- Arbitrary grid
- Disaggregation of cell relations
The primary use-case in the xMND context will be the revenue distribution for integrated PT services

Use-case revenue distribution for PT

<table>
<thead>
<tr>
<th>Principle</th>
<th>Measurement</th>
<th>Calculation for DB SBM</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
<td>One entry each vehicle</td>
<td>( \frac{1}{1 + 1 + 1} ) \times 10 €</td>
<td>3.33 €</td>
</tr>
<tr>
<td>Pkm</td>
<td>Kilometres travelled</td>
<td>( \frac{20}{20 + 10 + 2} ) \times 10 €</td>
<td>6.25 €</td>
</tr>
<tr>
<td>Tarif zones(^1)</td>
<td>Rail: 3.5 Regional bus: 2 Urban bus: 0.5</td>
<td>( \frac{3.5}{3.5 + 2 + 0.5} ) \times 10 €</td>
<td>5.83 €</td>
</tr>
<tr>
<td>Entries und Pkm</td>
<td>15 % und 85 %</td>
<td>3.33 € \times 15% + 6.25 € \times 85%</td>
<td>5.81 €</td>
</tr>
</tbody>
</table>

Assumption: single ticket price 10 €

\(^1\) Assumption: Interchange zones count 50% for each provider
Thank you for your attention!

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